

# Computerized simulative method of three dimensions outline of log<sup>1)</sup>

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**Abstract** Log centering accuracy depends on the computerized simulative level of its three-dimension outline. In this paper, the basic methods about distinguishing three dimensions outline of log by means of computerized simulation are discussed. It is suggested that straight lines or certain curves should be introduced to connect the separated points along some log generatrices. Taking bent logs for example verify the accuracy of computerized simulative method.

**Key words:** Computerized simulation, Three dimensions outline, Log

## Introduction

In the woodworking process, it is usually necessary to determine the best-oriented center of log, which is especially important for peeling blocks. How much percentage recovery is considered to be the judgement if it is the best log center, so it is necessary to find out the maximum inscribed cylinder. Therefor, the main problem of log centering is to describe three dimensions outline of log.

## Methods

It is necessary to scan log at several cross-sections and many different points in order to describe its three dimensions outline actually (Fig. 1, Raute 1994). According to scanning data, cross-section outline of log is simulated on computer first, then its maximum inscribed circle and the place of circle center is found out (Skatter 1998; Jin 1999). The number of measured cross section of log depend on the condition of its outline characteristic, length and accuracy centering demand. More cross sections should be selected as a log has considerable length, complicated outline and high accuracy centering needed. At the normal condition, four cross-sections at least should be selected as the objects of scanning and taking data.

As distinguishing three dimensions outline of log by computerized simulation, how to connect the correspond points into a curve similar to the true log generatrice is the key problem to resolve. Logs having ideal outline, no bent or bent level less than 3% (Fig. 2), straight lines are introduced to connect every separated points in order, which is enough to suit the

demand for centering accuracy. For bent logs which bent over normal degree (Fig. 3), a curve such as 3 cubic equation (Tang 1994) or B-spline curves (Qin 1996) should be used to connect every separated points so that true three dimensions outline of log can be correctly shown.

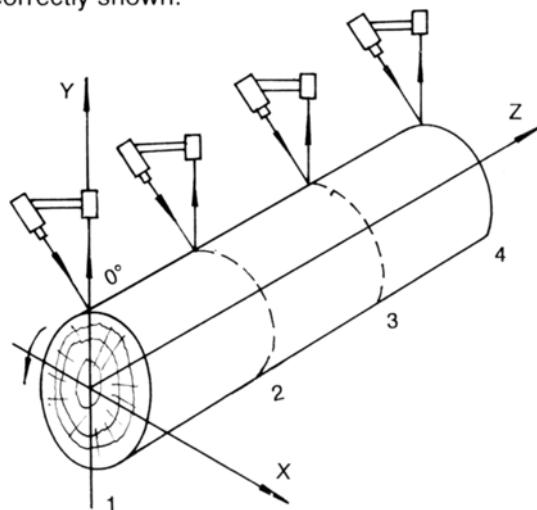


Fig. 1. Scanning log cross sections



Fig. 2. Ideal log (Pine)

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A coordinate  $X$ ,  $Y$ ,  $Z$  is located on a log (Fig.1). There are  $n$  known points along log generatrice  $M_1(z_1, y_1)$ ,  $M_2(z_2, y_2)$ ,  $M_3(z_3, y_3)$ , ... The distance  $h$  every two points are equal. The curve connecting

these points can be described by 3 cubic function  $F(z)$ . Expanding  $F(z)$  in accordance with Taylor series as follows:

$$F(z) = y_i - F'(z_i)(z-z_i) + F''(z_i)(z-z_i)^2/2 + [F'''(z_{i+1}) - F''(z_i)](z-z_i)^3/6h \quad (1)$$

Where  $F'(z_i)$  calculated with  $i$  decrease:

$$F'(z_{n-1}) = b_{n-1} / a_{n-1} \quad (2)$$

$$F'(z_i) = [b_i - F'(z_{i+1})] / a_i \quad (3)$$

$i = n-2, \dots, 2$

$F'(z_i)$  calculated with  $i$  increase:

$$F'(z_1) = e_2 / h - F'(z_1)h/3 - F'(z_2)h/b \quad (4)$$

$$F'(z_i) = F'(z_{i-1}) + [F'(z_{i-1}) + F'(z_i)]h/2 \quad (5)$$

$$e = y_i - y_{i-1}$$

Referring to reference Tang Zesheng *et al.* to determine other parameters.

Taking the log outline in Fig. 3, for example, scanning the log outline along 4 cross sections at every 10-degree (Table 1). According to measured data, 36 curves similar to the log generatrices can be obtained. These curves connect together along circle direction pass 4 known cross sections. The three dimensions outline of log is simulated on computer screen.

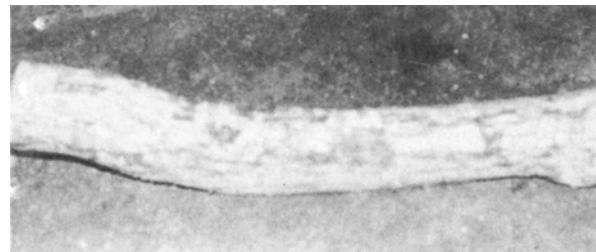


Fig. 3. Bent log (Elm)

Table 1. Measured data of along log generatrices

Location (°)	Data				Location (°)	Data			
	1	2	3	4		1	2	3	4
0	101	118	92	65	180	93	76	65	97
10	101	118	87	60	190	93	79	66	99
20	101.5	118	82	57	200	92	77	72	102
30	99	116	79	56	210	94.5	77	77	105
40	98	115	75	54.5	220	95	79	83	107
50	97	114	75	57.6	230	92	81	90	107
60	98	112	69	57	240	93	82	93	106
70	99	106	65	57.6	250	96	84	98	106
80	100	99	64	58	260	97	87	103	106
90	100	90	61	54	270	96	90	108	104
100	101	85	56	58	280	95	94	112	103
110	102	82	55	62	290	95	101	113	100
120	101	78	55	65	300	93	108	111	95
130	99	77	52	71	310	91	113	111	91
140	96	79	51	75	320	92	117	110	85
150	96	83	55	82	330	94	117	109	82.5
160	96	79	57	88	340	97	118	103	77
170	95	77	61	92	350	98	118	98	71

## Conclusion

It is necessary to measure more points on several cross sections of log to describe its three dimensions outline correctly. Straight-line equation can be introduced to connect the points into log generatrices for ideal ones. But a curve, such as 3 cubic equation, should be used for bent logs. A perfectly three dimensions outline of log can be obtained by means of computer simulation.

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